Muchie *BMC Nutrition* (2016) 2:51
DOI 10.1186/s40795-016-0093-3

BMC Nutrition

RESEARCH ARTICLE Open Access

Determinants of severity levels of anemia among children aged 6–59 months in Ethiopia: further analysis of the 2011 Ethiopian demographic and health survey

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Abstract

Background: Childhood anemia is the major public health problem in Ethiopia. It has been implicated with growth retardation, impaired motor and cognitive development, and childhood morbidity and mortality. Thus this study aimed to identify determinants of severity levels of anemia in children aged 6 to 59 months in Ethiopia.

Method: The study was further analysis of the 2011 Ethiopian Demographic and Health Survey. A total of 7636 children aged 6 to 59 months with complete information on the selected predictors were included in the analysis. Proportional odds model of ordinal logistic regression was used to identify determinant factors. Chi-square test of parallelism was used to evaluate the appropriateness of proportional odds assumption. A *p*-value less than 0.05 was considered as statistically significant.

Results: The Chi-square test of parallelism showed that the odds ratios were constant across all cut-off points of childhood anemia status at 5 % level (*p*-value = 0.071). Of the total children sampled, 28.6 and 21.7 % of them were severely/moderately and mildly anemic, respectively. Wasting, Stunting, religion, and age of the child, current employment status of the mother, educational status of the partner, number of under-5 children in the household, source of drinking water and mother's anemia status were found to be statistically significant determinants of severity levels of childhood anemia.

Conclusions: The likelihoods of being severely/moderately anemic as compared to being mildly/non-anemic, and being severely/moderately/mildly anemic as compared to being non-anemic were similar for a given variable keeping all others. Long term and short term nutritional status of young aged children, access to health and nutritional education, and access to safe drinking water should be improved by the concerned body.

Keywords: Anemia, Children aged 6–59 months, Determinants, Ordinal logistic regression, Severity levels

Abbreviations: AIDS, Acquired immunodeficiency syndrome; CSA, Central statistical agency; D, Deviance test statistic; EDHS, Ethiopian demographic and health survey; HIV, Human immunodeficiency virus; OR, Odds ratio; POM, Proportional odds model; WHO, World Health Organization

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Background

Anemia is a condition characterized by a low level of hemoglobin in the blood [1]. Although it affects individuals in all stages of life, preschool children and pregnant women are highly vulnerable. Anemia is a widespread public health problem, and severe anemia is a significant cause of childhood mortality [2]. World Health Organization (WHO) considers anemia prevalence over 40 % as a major public health problem, between 20 and 40 % as a moderate public health problem, and between 5 and 20 % as a mild public health problem [1]. High prevalence of anemia and its negative consequences for children's health, especially for their growth and development, have made anemia as an important public health problem, given the difficulty in implementing effective measures for controlling it [3]. Therefore, to design effective intervention strategies in populations where anemia is common, understanding determinants of anemia and their individual strength of association has a paramount importance [3, 4]. Anemia is multifaceted in etiology. Socioeconomic, nutritional, demographic, environmental and cultural characteristics had been associated with anemia; and the actions required have to encompass pertinent and relevant matters within the context of public health [3, 5].

Different levels of severity of anemia (i.e., mild, moderate and severe) are sometimes combined for analysis and reporting. However, if they are reported separately more complete information would be obtained as the differences between them are meaningful theoretically as well as empirically.

The WHO estimated that 1.6 billion people were anemic worldwide, and approximately two-thirds of preschool children in Africa and south East Asia were anemic [6]. Furthermore, according to WHO report, more than half of the world's preschool-age children (56.3 %) reside in countries where anemia is a major public health problem [6, 7]. In sub-Saharan Africa, it is a major public health problem among preschool-age children. In this region, much of the national prevalence is estimated to be above 40 % among this group [8]. In Ethiopia, 54 and 44 % of under-five children were anemic in 2005 and 2011, respectively [9].

Even though the government of Ethiopia applied tremendous efforts, childhood anemia was a major public health problem according to WHO criteria. Many researches had been conducted to show its prevalence and associated factors. However, some of the studies were derived from research conducted in specific localized groups which were not representative of the entire Ethiopia [10–12]. Despite the study conducted by Habte et al. was representative of Ethiopia, it only focused on maternal determinants of childhood anemia where socio-demographic and nutritional factors were not considered [13]. Hence, until now there was no population based study permitting generalization about the different severity levels of anemia and its principal determinants among children aged 6 to 59 months in Ethiopia.

Therefore, the present study aimed to identify the determinants associated with different severity levels of anemia among children aged 6 to 59 months in Ethiopia. It was hoped that the results of the study will help to improve policy makers' understanding for effective and efficient application of rational planning and allocation of resources for preventive and control actions against anemia among children in the country.

Methods

Study design and sample size

The study was further analysis of the 2011 Ethiopian Demographic and Health survey (EDHS) data. EDHS is periodical survey with five years interval, sometimes different from five with special cases. The 2011 EDHS was conducted on a nationally representative sample of nine regions and two city administrations of the country. It was conducted from September 2010 to January 2011 to provide current and reliable data on fertility and family planning behavior, child mortality, adult and maternal mortality, children's nutritional status, use of maternal and child health services, knowledge of HIV/AIDS, and prevalence of HIV/AIDS and anemia. Samples were selected using stratified two-stage cluster design technique taking census enumeration areas as the sampling units. In the first stage, 624 clusters of enumeration areas were selected from the list of the 2007 Population and Housing Census sample frame. A total of 17,817 representative households were selected for the 2011 EDHS. Hemoglobin was measured onsite using battery operated portable Hemacue analyzer from finger prick for all children aged 6–59 months, and women aged 15–49 years. The detail of the methodology is available in the EDHS 2011 report [9]. Only households having children aged 6–59 months were considered for this study. Data of 7636 children aged 6 to 59 months with complete information on the selected predictors of childhood anemia status were used.

Variables and source of data

The 2011 EDHS data were obtained from Central Statistical Agency (CSA), Addis Ababa, Ethiopia. The outcome variable in this study was anemia status of children aged 6 to 59 months categorized into three: severe or moderate, mild, and non-anemic. Anemia status was determined based on hemoglobin concentration in blood adjusted to altitude. Adjusted concentration 10.0–10.9 g/dl was considered as mild anemia, 7.0-9.9 g/dl as moderate anemia and less than 7.0 g/dl as severe anemia.

This study tried to include the most important expected determinants of anemia from various literature reviews [3, 5, 10–19], and their theoretical justification from the source of data [9]. The explanatory variables at individual and household levels included were child's size at birth, sex of child, child's age, stunting status of child, wasting status of child, mother's educational level, husband/partner's educational level, mothers' anemia status, mothers' age, mothers' marital status, mothers' current employment status, place of residence, religion of child, source of drinking water, number of under five years old children in the household and child's birth order.

Method of analysis

Ordinal logistic regression model was employed because of child anemia status is ordered. Specifically, proportional odds model (POM) was employed because of the following appealing features: (a) it is invariant under several categories as only the signs of the regression coefficients change when the coding of the response variable are inverted [20, 21]; (b) it is invariant under collapsibility of the ordered categories as the regression coefficients do not change when response categories are collapsed or the category definitions are changed [22]; and (c) it produces the most easily interpretable regression coefficients as $\exp(-\beta)$ is the homogenous odds ratio (OR) over all cut-off points summarizing the effects of the explanatory variables on the response variable in a single frequently used measure [20].

The POM for the categorical variable Y with C ordered categories and a collection of P explanatory variables for the $\boldsymbol{l}^{th}$ subject $\boldsymbol{X}_{\boldsymbol{l}}^{'} = \left(x_{1\boldsymbol{l}}, x_{2\boldsymbol{l}}, \ldots, x_{p\boldsymbol{l}}\right)$, $\boldsymbol{l} = 1, 2, \ldots, n$ is given as:

$$\begin{aligned} logit[Y_{\boldsymbol{l}} \leq i|\boldsymbol{x}_{\boldsymbol{l}}] &= \log\left[\frac{\pi_i(X_{\boldsymbol{l}})}{1-\pi_i(X_{\boldsymbol{l}})}\right] \\ &= \alpha_i - \beta_1 x_{1\boldsymbol{l}} - \ldots - \beta_p x_{p\boldsymbol{l}} \\ &= \alpha_i - \boldsymbol{X}_{\boldsymbol{l}}^{'}\beta \; for \; i = 1, 2, \ldots, c-1; l = 1, 2, \ldots, n \end{aligned}$$

where $\pi_i(X_{\boldsymbol{l}}) = Pr\ (Y_{\boldsymbol{l}} \leq i|X_{\boldsymbol{l}})$ and β is a column vector of P regression coefficients and α_i is $\boldsymbol{i}^{th}$ intercept coefficient.

After the best model has been chosen, test of parallelism was assessed. A non-significant chi-square test of parallelism was taken as evidence that the logit surfaces are parallel and that the odds ratios can be interpreted as constant across all possible cut-off points of the outcome variable.

Results

Characteristics of the study sample

From the sampled children, 28.6, 21.7 and 49.7 % were severely or moderately anemic, mildly anemic, and non-anemic, respectively. Out of children who resided in rural areas, 22.0 % were mildly anemic, and 29.6 % were severely or moderately anemic. These figures were 19.9 and 23.5 % for those children who resided in urban areas, respectively (Table 1).

Determinants of severity levels of child anemia

The result of uni-variable ordinal logistic regression analysis indicated that the variables sex (p-value = 0.122) and marital status (p-value = 0.605) were not significant at 10 % level. Hence, the final multivariable model excludes sex and marital status from the analysis. For this model the deviance based chi-square test provided a chi-square value of 1429.661 (p-value < 0.0005) which implied that the model had good fit. Furthermore, the Chi-square test of parallelism showed that odds ratios appeared to have held constant across all cut-off points of childhood anemia status for the final model at 5 % level (p-value = 0.071). Since the parallel lines assumption was held, the interpretation of the result obtained by modeling severely/moderately anemic versus mildly/non-anemic; and anemic versus non-anemic were the same.

As shown in Table 2, the result indicated that severely stunted children were 1.92 (OR =1.92; 95 % CI: 1.71 – 2.15; p-value < 0.0005) times more likely to be at higher anemia status as compared to non-stunted children. Similarly, moderately stunted children were 1.26 (OR =1.26; 95 % CI: 1.13 – 1.41; p-value < 0.0005) times more likely to be at higher anemia status as compared to those who were non-stunted.

As compared to non-wasted children, being at higher anemia status was 1.42 (OR =1.42; 95 % CI: 1.09 – 1.85; p-value = 0.01) and 1.30 (OR =1.30; 95 % CI: 1.11 – 1.52; p-value = 0.001) times more likely for severely wasted and moderately wasted children, respectively.

The estimate implied that children in the age range of 6 to 11 months were 5.05 (OR =5.05; 95 % CI: 4.25 – 5.99; p-value < 0.0005) times more likely to be at higher anemia status as compared to those in the age range of 48 to 59 months. Similarly, the likelihood of being at higher anemia status was 3.97 (OR =3.97; 95 % CI: 3.45 – 4.57; p-value < 0.0005) times higher for children in the age range of 12 to 23 months compared to those in the age range of 48 to 59 months.

Furthermore, the results illustrated that the odds of being at higher anemia status was higher for children from non-employed mothers (OR = 1.13; 95 % CL: 1.02–1.25; p-value = 0.051).

On the other hand, the odds of being at higher anemia status were lower for children whose households used improved source of drinking water (OR = 0.87; 95 % CL: 0.79–0.96; p-value = 0.006), whose mothers' partners/husbands were at primary educational level as compared to illiterate (OR = 0.86; 95 % CL:0.77–0.95; p-value = 0.004).

Table 1 Percentage distribution of anemia status and covariates

Variables	Categories	Child's Anemia status			Total
		Non-anemic	Mild	Severe or moderate	
Mother's age (years)	15–24	47.7 %	22.3 %	30.0 %	22.2 %
	25–29	50.2 %	21.1 %	28.7 %	31.8 %
	30–34	48.2 %	21.8 %	30.0 %	21.4 %
	35–49	52.1 %	21.8 %	26.1 %	24.7 %
Type of place of residence	Rural	48.4 %	22.0 %	29.6 %	84.6 %
	Urban	56.7 %	19.9 %	23.5 %	15.4 %
Mother's educational level	Primary, Secondary or higher	55.5 %	21.5 %	23.0 %	29.0 %
	Illiterate	47.3 %	21.8 %	30.9 %	70.9 %
Source of drinking water supply	Improved	52.9 %	20.6 %	26.5 %	50.5 %
	Non-improved	46.4 %	22.8 %	30.8 %	49.5 %
Religion	Orthodox	62.6 %	19.0 %	18.4 %	32.6 %
	Protestant	58.0 %	22.9 %	19.1 %	20.9 %
	Muslim	37.0 %	23.0 %	40.0 %	46.6 %
Number of children under 5 in household	3 or above	42.9 %	22.6 %	34.6 %	18.7 %
	Two	48.2 %	22.2 %	29.5 %	48.5 %
	One	55.8 %	20.4 %	23.9 %	32.8 %
mother's anemia status	Severe or moderate	33.8 %	22.2 %	44.0 %	7.3 %
	Mild	38.7 %	23.9 %	37.4 %	16.5 %
	Non-anemic	53.6 %	21.1 %	25.2 %	76.1 %
Mother's marital status	Currently in union/living with a man	49.5 %	21.6 %	28.8 %	93.5 %
	Formerly in union/living with a man	52.4 %	22.2 %	25.4 %	6.4 %
Husband/partner's education level	Secondary or higher	56.2 %	19.1 %	24.7 %	9.8 %
	Primary	53.7 %	22.6 %	23.7 %	37.1 %
	Illiterate	45.7 %	21.5 %	32.8 %	53.1 %
Mother's current employment status	Not working	47.3 %	22.1 %	30.6 %	69.6 %
	Working	55.2 %	20.7 %	24.1 %	30.4 %
Birth order number	6 +	46.9 %	23.7 %	29.4 %	26.5 %
	4 – 5	47.2 %	22.4 %	30.4 %	23.7 %
	2 – 3	51.0 %	20.6 %	28.4 %	31.7 %
	1	54.8 %	19.7 %	25.6 %	18.1 %
Sex of child	Male	49.6 %	21.2 %	29.2 %	51.2 %
	Female	49.8 %	22.2 %	28.1 %	48.8 %
Child's Size at birth	Large	51.0 %	22.2 %	26.8 %	29.6 %
	Average	52.0 %	20.3 %	27.7 %	39.7 %
	Small	45.5 %	22.9 %	31.6 %	30.8 %
child age grouped	6 –11	30.5 %	26.5 %	43.0 %	10.8 %
	12 – 23	36.2 %	22.9 %	40.9 %	20.5 %
	24 – 35	47.8 %	21.9 %	30.3 %	21.9 %
	36 – 47	57.0 %	20.5 %	22.6 %	24.0 %
	48 – 59	65.1 %	19.3 %	15.6 %	22.8 %

Table 1 Percentage distribution of anemia status and covariates *(Continued)*

Wasting status of Child	Severely wasted	33.5 %	21.1 %	45.4 %	2.9 %
	Moderately wasted	38.0 %	25.4 %	36.6 %	8.7 %
	Non-wasted	51.4 %	21.3 %	27.3 %	88.6 %
Stunting status of Child	Severely stunted	40.0 %	22.9 %	37.1 %	22.6 %
	Moderately stunted	51.5 %	21.7 %	26.8 %	24.3 %
	Non-stunted	53.0 %	21.1 %	25.8 %	53.0 %
Total		49.7 %	21.7 %	28.6 %	100 %

The results showed that the odds of being at higher anemia status were higher for children from households with two (OR = 1.17; 95 % CL: 1.05–1.30; p-value = 0.005) and three or more (OR = 1.30; 95 % CL: 1.13–1.49; p-value < 0.0005) under-five children. Similarly, the odds of being at higher anemia status were higher for children whose mothers were at higher severity level of anemia; mothers with Severe/moderate (OR = 1.84; 95 % CL: 1.55–2.18; p-value < 0.005) and mild (OR = 1.57; 95 % CL: 1.40–1.77; p-value < 0.0005).

In this study, the religious affiliation of the child was also found out to be significantly associated with children anemia status. The likelihood of being at higher anemia status to Orthodox and Protestant children were 62.3 % (OR = 0.38; 95 % CL: 0.34–0.42; p-value < 0.0005) and 56.1 % (OR = 0.44; 95 % CL: 0.39–0.50; p-value < 0.0005) lower than those children whose mothers are Muslim, respectively.

Discussions

From the Chi-square test of parallelism, the likelihood of being severely/moderately anemic as compared to being mildly/non-anemic and the likelihood of being severely/moderately/mildly anemic as compared to being non-anemic was similar for a given variable keeping all others among variables studied.

The result indicated that severely/moderately stunted children were more likely to be severely/moderately anemic as compared to non-stunted. This result was consistent with the finding that stunting was associated with increased risk of anemia in children 6 to 59 months, and that anemia prevalence in children with stunting was twice that of children with normal stature [14]. It was also consistent with the finding that stunted children were 2.7 times more likely to be anemic than their counterpart [10]. This finding also agreed with other studies conducted in Bangladesh [23], Brazil [24], Burma [25] and Kenya [26]. Moreover, the likelihood of being anemic was high in wasted children. Since stunting and wasting are long-term and short-term indicators of malnutrition, the implication of the results was that undernourished children experience higher risk of developing anemia as compared to nourished children. The possible explanation could be due to the fact that anemia and malnutrition often share common causes; it is expected that multiple types of malnutrition would coexist in the same individuals, and increase the development of anemia in synergetic manner. Besides, the gastrointestinal epithelium disturbance in malnourished individuals may reduce absorption, and contribute towards development and worsening of anemia [11]. Consequently, low hemoglobin level may also compromise the linear growth of the children [27].

The results also showed that the likelihood of children in the age range of 6 to23 months being severely/moderately anemic was higher than those in the age range of 48 to 59 months, holding all other variables constant. The result of the study was consistent with the result of various studies [11, 15–17]. One of the possible explanations for the higher likelihood of anemia might be related to low balanced nutritional intakes that may not be sufficient for their rapid growth related demands [28]. The other possible reasons might be due to the fact that poor infant and young children feeding practices particularly timely initiation of complementary food is low in Ethiopia as evidenced by published data of 2005 and 2011 EDHS survey [29].

The results revealed that the odds of being severely/moderately anemic were higher for children from non-employed mothers. This result was consistent with the finding that children of working mothers were at lower risk of anemia [14].

Moreover, the odds of being severely/moderately anemic were higher for children whose households used non-improved source of drinking water. This result agreed with the result that the occurrence of anemia was 1.68 times higher for children from households that consume untreated water as compared to those children from households that consume treated water [14]. Precarious sanitation conditions are linked with anemia, even if indirectly. Since such conditions are associated with greater number of infectious and parasitic diseases, which in turn contributed towards diminishing the hemoglobin levels.

From the results, the odds of being severely/moderately anemic were higher for children whose mothers'

Table 2 Parameter estimates of related covariates in the final proportional odds model

Variables	Categories	OR	*P*-value	95 % CI of OR	
				LB	UB
Mother's age (years)	15–24	1.07	0.522	0.88	1.29
	25–29	1.03	0.673	0.88	1.21
	30–34	1.12	0.11	0.97	1.30
	35–49 (ref)				
Type of place of residence	Rural	1.04	0.582	0.90	1.21
	Urban (ref)				
Mother's educational level	Primary/Secondary/higher	0.92	0.186	0.82	1.04
	No education (ref)				
Source of drinking water supply	Improved	0.87	0.006	0.79	0.96
	Non improved (ref)				
Religion	Orthodox	0.38	.000	0.34	0.42
	Protestant	0.44	.000	0.39	0.50
	Muslim (ref)				
Number of children 5 and under in household	3 or above	1.30	.000	1.13	1.49
	Two	1.17	0.005	1.05	1.30
	One (ref)				
Mother's anemia status	Severe or moderate	1.84	.000	1.55	2.19
	Mild	1.57	.000	1.40	1.78
	Not anemic (ref)				
Husband/partner's education level	Secondary or higher	1.04	0.667	0.86	1.26
	Primary	0.86	0.004	0.77	0.95
	No education (ref)				
Mother's current employment status	Not working	1.13	0.015	1.02	1.25
	Working (ref)				
Birth order number	6 +	1.05	0.655	0.86	1.28
	4 – 5	1.13	0.188	0.94	1.35
	2 – 3	1.01	0.922	0.87	1.17
	1 (ref)				
Child's Size at birth	Large	0.97	0.557	0.86	1.09
	Average	0.95	0.308	0.85	1.05
	Small (ref)				
Child age (years)	6 – 11	5.06	.000	4.25	6.01
	12 – 23	3.98	.000	3.45	4.59
	24 – 35	2.11	.000	1.83	2.42
	36 – 47	1.47	.000	1.28	1.68
	48 – 59 (ref)				
Wasting status of Child	Severe	1.42	0.01	1.09	1.85
	Moderate	1.30	0.001	1.11	1.52
	Not wasted (ref)				
Stunting status of Child	Severe	1.92	.000	1.71	2.15
	Moderate	1.26	.000	1.13	1.41
	Not stunted (ref)	1.07			

partners/husbands were illiterate. Related study showed that, education has a relationship with the capacity to grasp the knowledge needed for adequate healthcare and nutrition for children; just as it provides a chance to join the labor market and probably better socioeconomic conditions [18]. This may be because educated partners have better health and nutrition knowledge and child rearing practices than uneducated ones which both contribute to improved child health. Therefore, it is useful to improve partners' access to education in all areas in order to address the problem through improving their income earning capacity and also enhancing the quality of care and attention they can provide to their children.

Additionally, at the household level, the results indicated that the higher anemia status was more likely for children from households with greater number of children under the age of five years in Ethiopia. This agreed with the result of other study done in Brazil [19]. The possible justification could be due to the fact that the household with greater number of children has high demand and expenditure for food to satisfy the needs of members of the family. In conjunction, this may worsen the quality of care for children, and increase the risk of anemia not only for children but also for adults.

The results also implied that higher child anemia status was more likely for children from severely/moderately anemic and mildly anemic mothers compared to those from non-anemic mothers. This result was consistent with other finding that maternal anemia was associated with increased risk of anemia in children 6 to 59 months [14]. The possible reason might be related to shared socio-economic status of the family which may affect both children and their mothers, and leading to anemia.

Based on the religious affiliation of the child, the likelihood of severe/moderate anemia to Orthodox and Protestant children are lower than those Muslim children. Here religious affiliation has impact on severity levels of child anemia status. This result was supported by other related studies conducted in North-East India [30] and India [31].

Limitations

The data used was secondary which was obtained from cross sectional survey. As a result there may be cause-effect relationship dilemma. Furthermore, this study did not include all modifiable risk factors like current status/history of infectious disease particularly those which have a potential role in dysregulating erythropoiesis such as HIV, intestinal parasites and malaria. Moreover, in this study only hemoglobin value was measured to define anemia. However, in the areas where micronutrient deficiencies and hemoglobinopathies are prevalent measuring serum hematinics level and detecting hemoglobinopathies along with hemoglobin level gives appealing evidences for public health intervention.

Conclusions

The likelihoods of being severely/moderately anemic as compared to being mildly/non-anemic and of being severely/moderately/mildly anemic as compared to being non-anemic were similar for a given variable keeping all others variables. The study revealed that nutritional status of the child (wasting status and stunting status), current employment status of mother, religion of the child, educational status of partner, age of child, number of children under-5 in the household, source of drinking water and mother's anemia status were the most important determinants of severity levels of child anemia in Ethiopia in 2011. Consequently, a number of interventions required to reduce high prevalence of anemia for children in Ethiopia were recommended. These include: First, Policies and plans have to be put in place to reduce the prevalence of mothers' anemia. Second, Efforts like health, nutritional and family planning education, and follow up of both long term and short term nutritional status should be made to young aged children. Third, Improve partners' access to education in all areas to enhance the quality of care and attention they can provide to their children. Finally, Efforts should be made to improve access to safe drinking water and job opportunities to mothers.

Additional file

Additional file 1: NUTN-D-15-00006 last used data (an excel file up on which all the results of the manuscript was based). (XLS 1979 kb)

Acknowledgement

I would like to thank the Ethiopian Central Statistics Agency for providing me with all the relevant secondary data used in this study. Next to this, I also would like to express my deepest gratitude to my wife Betelhem Tigabu for her continued support and initiation. Finally, I would like to thank all who directly or indirectly supported me.

Funding

I did not receive external funding for this research.

Availability of data and materials

Fully anonymized data supporting the findings of this study can be found in Additional file 1.

Authors' contributions

KFM designed the study, performed the statistical analysis, interpreted the results and prepared the manuscript. The author also read and approved the final manuscript.

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Competing interests
The author declares that he has no competing interests.

Consent for publication
This manuscript does not contain any individual person's data.

Ethics approval and consent to participate
Ethical clearance for the 2011 EDHS was provided by the Ethiopian Health and Nutrition Research Institute (EHNRI) Review Board, the National Research Ethics Review Committee (NRERC) at the Ministry of Science and Technology, the Institutional Review Board of ICF International, and the communicable disease control (CDC). Additionally, written consent for participation was obtained from each respondent; consent for children was obtained through the parents, caregivers or guardians. However, the dataset of the 2011 EDHS is not available as a public domain survey dataset. The author requested access to the data from Director of Central Statistics Agency of Ethiopia and access was granted to use the data for this research.

Received: 20 July 2015 Accepted: 11 August 2016
Published online: 17 August 2016

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